Special Issue on Proceedings of International Conference on Materials Manufacturing and Nanotechnology, June 2021. International Journal of Aquatic Science, Vol 12, Issue 03, 2021

SUSTAINABILITY ASSESSMENT OF COIMBATORE CITY BY REMOTE SENSING AND GIS

P.Selvaram- Assistant Professor, R. Aarthi-- Assistant Professor

Department of Civil Engineering
Nehru Institute of Technology
selvainpollachi@gmail.com - corresponding author

Abstract—Sustainability assessment is a very crucial task which is necessary to be computed for every region in order to understand the development of any region. Sustainability is the horizon which all departments are focusing in this generation. If sustainability left unconsidered the world is expected to face an environmental catastrophe. The assessment of sustainable development is necessary for every developed and developing nation. This can be made feasible using the remote sensing and GIS technique. The sustainability development depends on various factors among which the natural resources play a vital role. The importance of natural resources in sustainability development is discussed in this paper. The temporal satellite imagery of Coimbatore city has been obtained in order to analyze the sustainable development of Coimbatore city. The major classes of natural resources have been extracted from the land use / land cover map and sustainability based on natural resources has been assessed. From the results obtained it is well understood that the sustainability of the city has been decreasing yearly to a certain extent

INTRODUCTION

Sustainable development is a process of meeting human development goals while sustaining the ability of nature systems to provide the natural resources and eco-system services upon which the economy and society depends. Sustainable development has its focus more on economic development, social development and environmental protection, among which natural resources play a vital role. Ability to access and process information quickly while displaying it in a spatial and visual medium allows organization to improve decision making and promote better organization integration and knowledge management.

Sustainable development is the organizing principle for meeting human development goals while at the same time sustaining the ability of natural systems to provide the natural resource and ecosystem services upon which the economy and society depends. The desirable end result is the state of society were living conditions and resource use continue to meet human needs without undermining the integrity and stability of natural systems.

While the modern concept of sustainable development is derived mostly from the 1987 Brundtland report, it is also routed in earlier ideas about sustainable forest management and twentieth century environmental concerns. As the concept developed, it has shifted to focus more on economic development,social development and environmental production for future generations. It has been suggested that the term ‘sustainability’ should be viewed as humanity’s target goal of human-ecosystem equilibrium, while sustainable development refers to the holistic approach and temporal processes that lead us to the end point of sustainability. The concept of sustainable development has been and still is subject of criticism.This can be achieved using GIS technique.

1.1 IMPORTANCE OF SUSTAINABILITY ASSESSMENT

Bringing out sustainable development is the major criteria which each departmentfaces in recent days.Assessment of sustainability is a tedious task as, sustainability depends upon various factors.

But it is essential to bring out a procedure to assess the sustainability.We have proposed to carry out a project to assess the sustainability of Coimbatore city considering the impact of natural resources in sustainability.

1.2 SUSTAINABILITY

Sustainability is defined as a requirement of our generation to manage the resource base such that the present generation can be satisfied with the natural resources without compromising the future demands.The effect due to the loss of sustainability is the global warming which is the major problem of the planet earth.Global warming is the increase of earth’s average surface temperature due to the effect of green house gases, such as carbon dioxide emission from burning fossil fuels or from deforestation, which trap heat that would otherwise escape from earth.

2.1 AIM

To analyze and assess the sustainability of Coimbatore city from the satellite imagery using image interpretation and GIS technique.

2.2 OBJECTIVES

Special Issue on Proceedings of International Conference on Materials Manufacturing and Nanotechnology, June 2021. International Journal of Aquatic Science, Vol 12, Issue 03, 2021

Satellite On Board	Type	Spectrum	Spectral Range (μm)	Multi-Spectral Resolution	Resolution Class
IRS1C&IRS1D	Imaging multi-spectral radiometers(visible/IR)	VIS	~0.40-~0.75	23.5x 23.5	Medium (20m-200m)
		NIR	~0.7 - ~1.3		
		SWIR	~1.3 - ~3.0		

The objectives of the present study are:

- To identify the factors that influence the sustainability of a region
- To analyze the impact of the factors affecting sustainability using temporal satellite data.
- To assess the sustainability of Coimbatore city and its rate of variation using GIS technique.

STUDY AREA AND DATA DESCRIPTION

The Coimbatore city region is taken into consideration to assess the sustainability. Remote sensing and GIS technique are proposed to be adopted for sustainability assessment. Image processing software and GIS software has been used for this application.

3.1 STUDY AREA

Table 3.1 Specifications of LISS III Sensor

District in the north and Erode district in the north-east.Itis one of the fast growing tier – 1 cities in India and a major hub for textiles, industries, commerce, education,informationtechnology,healthcare and manufacturing in Tamil Nadu. It is often referred to as the 'Manchester of South India' due to its cotton production and textile industries. Coimbatore city lies at Coimbatore is a major city in Tamil Nadu on the south of India. It is bounded byTirupur district in the east,Nilgris 11º0'45" N latitude and 76º58'17"E with an area of 95.41 km^2.The IRS(Indian Remote Sensing) satellite from a large family of Earth observation satellites operated by Indian space agency is the important remote sensing system. IRS 1C and IRS1D were launched in 1995 and 1997 respectively.These satellites carry LISS-III sensor as well as wide field of AWiFS sensor.LISS-III(Linear Imaging Self Scanning Sensor) sensor imagery is taken as the primary data.

3.2 SOFTWARE USED

Twosoft-wares were exclusively used for this study.For image processing and classification ERDAS Imagine software was used.ArcGIS is a geographic information system (GIS) for working with maps and geographic information. ArcGIS software was used for preparation of maps and for assessment of sustainability in Coimbatore city.

3.4.1 ERDAS Imagine

ERDAS Imagine is a remote sensing application with raster graphics editor abilities designed by ERDAS for geospatial applications. The latest version is 2015. ERDAS Imagine is aimed primarily at geospatial raster data processing and allows the user to prepare, display and enhance digital images for mapping use in geographic information system (GIS) or in computer-aided design (CAD) software. It is a toolbox allowing the user to perform numerous operations on an image and generate an answer to specific geographical questions.

By manipulating imagery data values and positions, it is possible to see features that would normally be visible and to locate geo-positions of features that would otherwise be graphical. The level of brightness or reflectance of light from the surfaces in the image can be helpful with vegetation analysis, prospecting for minerals etc. Other usage examples include liner feature extraction, generation of processing work flows ("spatial models" in ERDAS IMAGINE), import/export of data for a wide variety of formats, ortho-rectification, mosaicing of imagery, stereo and automatic feature extraction of map data from imagery.

3.4.2 ArcGIS

Special Issue on Proceedings of International Conference on Materials Manufacturing and Nanotechnology, June 2021. International Journal of Aquatic Science, Vol 12, Issue 03, 2021

ArcGIS is a geographic information system(GIS) for working with maps and geographic information. It is used for creating and using maps, compiling geographic data, analyzing mapped information, sharingdiscovering geographic information in a range of applications and managing geographic information in database.

ArcGIS includes the following Windows desktop software:

- ArcReader,which allows one to view and query maps created with other ArcGIS products.
- ArcGIS for Desktop Basic.
- ArcGIS for Desktop Standard.
- ArcGIS for Desktop Advanced

4.2.1 Data Collection

Data collection is the process of gathering and measuring informaion on targeted variables in an established systamatic fashion,which then evaluate outcomes.

The goal for all data collections is to capture quality evidence that then transalate to rich data analysis and allows the building of a convincing and crodible answer to questions that have been posed.

4.2.2Satellite imagery

Satellite imagery may consist of images of Earth or other planets collected by satellite.Imaging satellites are operated by governments and space orgnizations around the world.

4.2.3 Temporal data

A Temporal data base is a data base with build in support for handling data involving time being related to the slowly changing dimensions concept ,for example a temporal data model and a temporal version of structured overly language

4.2.4 Digitization

Digitization is the process of converting information into digital format In this format, information is organized into discrete units of data that can be separately. Using digitization process the Coimbatore city shape file was extracted from the toposheet.

4.2.5 Shape file

The shapefile format is a popular geospatial vector data format for Geographic Information System(GIS)software.It is a developed and regulated by ESRI as an open specification for data interoperability among ESRI and other GIS software products.

4.2.6 Layer stacking

Several types of measurement may be made from the ground area covered by a single pixel. Each type of measurement forms an image which carry some specific information about the area. By 'stacking' these images from the same area together, a multilayer image is formed. Each component image is a layer in the multilayer image.

Multilayer images can also be formed by combining images obtained from different sensors, and other subsidiary data.

4.2.7 Multispectral image

A multispectral image consists of a few image layers, each layer represents an image acquired at a particular wavelength band. The LISS III image consists of four bands. This case is that, each pixel of the scene has four intensity values corresponding to the four bands.

4.2.8 Mosaicing

It is the process of combining multiple photographic images with overlapping fields of view to produce a segmented panorama or high-resolution image. Commonly performed through the use of computer software, most approches to image stitching require merely exact overlaps between images and identical explosures to produces seemless results, although some stitching algorithms actually benefit from diffently exposed images by doing HDR (High Dynamic Range) imaging in regions of overlap. Some digital cameras can stitch their photos internally. Imge stitching is widely used in today's world in applications such as high resolution photo mosaics in digital maps and satellite photos, medical imaging, multi-image super-resolution, video stitching and object insertion.

4.2.9Image Classification

Image classification refers to the task of extracting information classes from a multiband raster image.The resulting raster from image classification can be used to create thematic maps.Depenting on the interaction between the analyst and the computer during classsification,there are two types of classification.

- Supervised classification
- Un supervised classification

Special Issue on Proceedings of International Conference on Materials Manufacturing and Nanotechnology, June 2021. International Journal of Aquatic Science, Vol 12, Issue 03, 2021

With the Arc GIS spatial analyst extension, there is a full suite of tools in the multivariate toolset to perform supervised and unsupervised classification. The classification process is a multi-step workflow, therefore, the image classification toolbar has been developed to provide an integrated environment to perform classification with the tools. Not only does the toolbar help with the workflow for performing unsupervised and supervised classification. It also contains additional functionality for analyzing input data, creating training samples and signature files. The recommended way to perform classification and multivariate analysis is through the image classification toolbar.

Supervised classification used the spectral signatures obtained from training samples to classify an image. With the assistance of the image classification toolbar, you can easily create training sample to represent the classes you want extract. You can also easily create a signature file from the training samples, which is then used by the multivariate classification tools to clssify the image.

Unsupervised classification finds spectral classes in a multiband image without the analysts intervention .The image classification toolbar aids in unsupervised classification by providing access to the tools to create the clusters, capability to analyze the quality of the clusters, and access to classsification tools.

4.2.10Sustainability Assessment

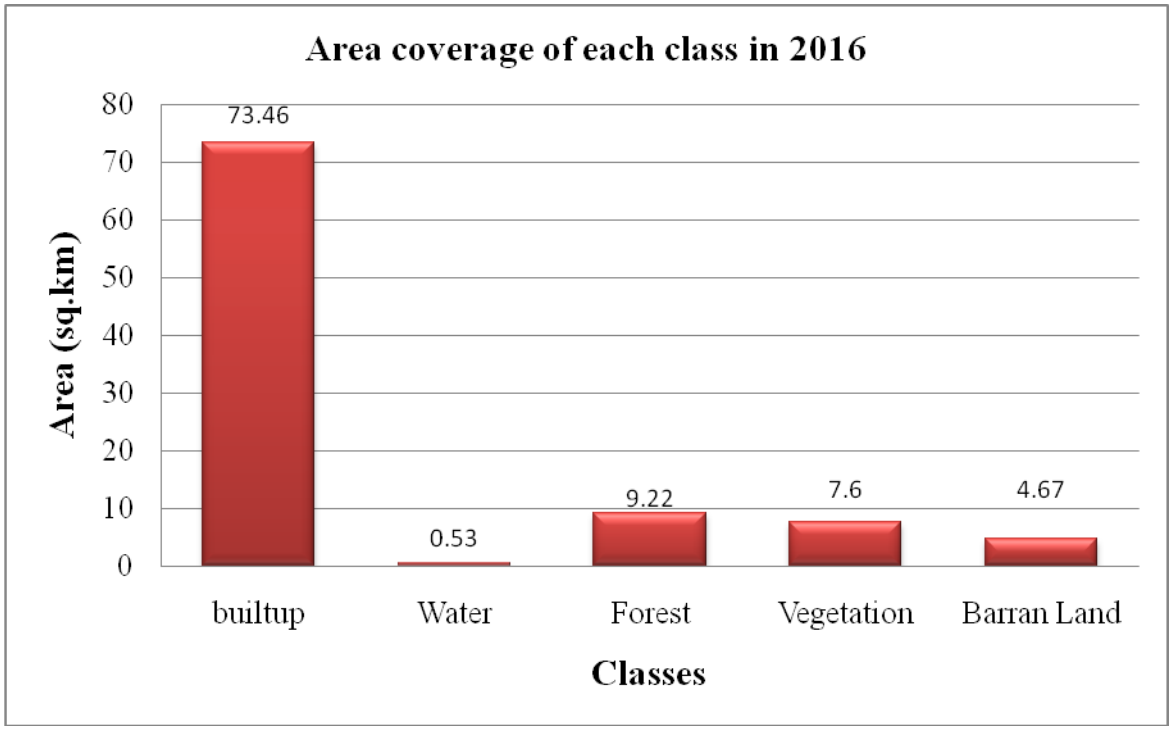
Sustainability assessment is a complex appraisal method it is conducted for supporting decision making and policy in abroad environmental context and transcend a purely technical & scientific evaluation.

RESULTS

The sustainability of any region can be analyzed based on various factors which influences the sustainability of any region. The major factor which affects the sustainability of any region is the natural resources which has been considered in this study. Based on the yearly changes in the natural resources, sustainability has been assessed.

.Area coverage of each class in 2010

CLASSES	AREA (sq.km)
Built up	**46.69**
Water	**1.71**
Forest	**18.17**
Vegetation	**23.24**
Barren land	**5.02**



Special Issue on Proceedings of International Conference on Materials Manufacturing and Nanotechnology, June 2021. International Journal of Aquatic Science, Vol 12, Issue 03, 2021

Fig 5.8 Area coverage of each class (2016)

CONCLUSION

The sustainability development has become the goal of day – to – day life. It is very essential to assess the sustainability in order to fulfil the goal. Although there exists various factors which influence the sustainability of any region, the sustainability development can be much influenced by bringing out changes in the natural resources. Thus it becomes essential to assess the conditions of the region by any means.

Remote sensing serves as a best technique to study about any region on a whole. The availability of temporal data enhances our assessment by giving us an oppurtunity to analyze the changes in the sustainable development over the years.

The Coimbatore city being the Manchester of South India, is a fast growing urban region. Population increase is an evitable challenge which the city is facing today. To provide all basic ammenities to the entire outflowing population in the challenging task which the city is going through.

Over the years there has been a vast difference in the climate of the region, which proves to be an effect of lack in sustainability. The balanced use of the resources is much essential for any region to be sustainable. The decrease in forest cover as shown in the results is a very evident proof to declare that the region is lacking in sustainable development. The vegatation cover is another bench mark which shows the poor sustainability of the city.

The Coimbatore city being an industrialized one has a high peak increase in the builtup areas. This eventually decreases the forest cover and the agricultural lands.The depletion in the forest cover proves a major reason for the climate adversity which eventually has lead to poor annual rainfall in the region. This has created a vulnerable indication to the city's water resources. The decrease in the area covering the water bodies over years has made it evident. The city is about to face a very dangerour water crisis in the future if the same situation prevails.

The availability of barren land can be made advantageous by incorporating many beneficial schemes for the sustainable development of the city. The afforestation is the primary solution to increase the city's sustainability. Though many non-government and private organizations take big leaps towards tree plantation, it yet seems to be a chellenging one.

Measures should be taken to increase the water resources in all available manner. The major problem which is approaching the city is water cricis which should be considered very before of its arrival. The proper and advantageous usage of barren land can help the city in unexpected manner. Whereas the depromotional usage of the same can push the city to an adversity very soon.The well being of any city can be truly justified only by assessing its sustainability development. Human live on this earth to make himself comfortable with all resources and also to nourish his descendants with the prosperity of the earth. This can be made feasible only if the sustainability is taken into account and the sustainable development is attained.

Sustainability development is the primary goal which every citizen should fulfil in order to safeguard our living, along with the betterment of our future generations. Only when each citizen tries to take step towards the development, the city can escape from the upcoming hazards.

Special Issue on Proceedings of International Conference on Materials Manufacturing and Nanotechnology, June 2021. International Journal of Aquatic Science, Vol 12, Issue 03, 2021

REFERENCES

1. Cesar A.Poveda et al "A review of sustainability assessment and sustainability / environmental rating system and credit weighting tools" Journals of sustainability development vol.4., no.6, dec 2011 pg 36-55.
2. Dorota Z. Haman and Donald A. Brown "Protection of Water Resources, Water Quality and Aquatic Ecosystems", Institute of Food and Agricultural Sciences, April 1994.
3. LusiBraganca et al "The journal of building sustainability assessment sustainability" ISSN 2071 - 1050"Sustainability 2010, 2, 2010-2023,doi10.3390/su2072010.
4. Martin J.Bunch et al "Using Geographic Information systems for Spatial Planning and Environmental Management in India:CriticalConsiderations".International Journal Of Applied Science and technology,Vol.2, No.2, February 2012.
5. Michael A.Nwachukwu et al "Application of GIS in sustainable ground water development Imo River Basin Nigeria" .International journal of water resource and environmental engineering .Vol.5(6),pp.310-320, june-2013,DOI 10.5897/IJWREE2012.0382.
6. Michelle L.M Graymore et al "Regional Sustainability: How useful are current tools of sustainability assessment at a regional scale?", Ecological Economics 67, July 2008.
7. Noriko Hosonuma et al "An assessment of deforestation and forest degradation drivers in developing countries", Environmental Research Letters, October 2012.
8. RadhikaKapur "Natural Resources and Environmental Issues", Journal of Ecosys and Ecograph, July 2016
9. S.K.Bhan et al "Use of remote sensing and GIS technology in sustainable aquaculture management and development", Indian Institute of Remote Sensing, NRSC, Dehradun.
10. Xiaoman Yu et al "Energy based sustainability assessment on natural resources utilization in 30 Chinese Provinces", Journal of Cleaner Production, May 2016.